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10/521912
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Clamart, 25 October 2004

International Patent Application no. **PCT/EP03/50262**
Applicants: **Services Pétroliers Schlumberger et al.**
Our Ref: **WO 21.1045**

Dear Sirs,

I refer to the Written Opinion dated August 27 2004 and enclose herewith triplicate copies of an amended set of claims to replace the claims presently on file.

With regard to the specific comments in item V of the written opinion, the applicants comment as follows:

New claim 1 is based on claims 1, 3 and 4 as filed. The new set of claims is believed to overcome the objection of novelty raised against claim 1 as filed. Document D1, DE 100 60 621 discloses a device for detecting speed and direction of rotation of a rotor 1 using a magnetic detection device (sensors 3 and 4) that is situated close to the rotor. This magnetic detection device issues signals Sa, Sb that are representative of the speed and direction of the rotation. However, document D1 only discloses means to determine whether the rotation speed of the rotor reaches a certain predetermined value. Nothing is said in this document that a precise indication of the rotation speed is given. It is not disclosed in this document that the frequency of the modulated current or the number of transitions of said modulated current reflects the speed of the object.

Document D2, WO 99/49322, describes a device for detecting a movement. Nothing in this documents reveals or even suggests current receptors means that create a modulation in a current circulating in a conductor (for supplying current), said modulation being reflective of both speed and direction of the rotation.

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New claim 16 has been amended to overcome objection raised against claim 18 as filed.

The applicants believe that this response addresses the issues raised by the examiner and request that a favorable international preliminary examination report be issued forthwith.

Yours faithfully,

A handwritten signature in black ink, appearing to read 'Raybaud', with a stylized flourish at the end.

Hélène RAYBAUD
European Patent Attorney

Encl.

CLAIMS

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1. Device for measuring the speed and direction of rotation of an object (3), near to which it is placed, said device comprising:

- a magnetic detection device (2) that delivers, in response to a rotation of the object (3) generating a magnetic field variation, signals representative of its speed and its direction of rotation,

- a conductor (4) intended to be connected to a power source to supply current to the magnetic detection device (2) at least,

- current receptor means (6) placed between the magnetic detection device (2) and the conductor (4) that create, from signals coming from the magnetic detection device (2), a modulation of the current (I_{out}) flowing in the conductor (4),

wherein,

- the frequency of the modulated current (I_{out}) or the number of transitions that it has reflects the speed of the object (3); and
- the form of said modulated current (I_{out}) reflects the direction of rotation of said object (3).

2. Device for measuring the speed and direction of rotation of an object (3) according to claim 1, characterised in that the current receptor means (6) comprise at least one series assembly (61, 62) formed of a resistor ($R1$, $R2$) and a commutation element ($Q5$).

3. Device for measuring the speed and direction of rotation of an object (3) according to claim 1 or 2,

characterised in that the magnetic detection device (2) is a linear sensor delivering two pairs of signals out of phase with each other, said signals being relative to the angular position of the object.

4. Device for measuring the speed and direction of rotation of an object (3) according to claim 3, characterised in that it comprises two comparators (C1, C2), the input of each receiving the signals of a pair, the output of each comparator (C1, C2) being connected to the conductor (4) via a resistor (R1, R2) of a series assembly, the two resistors (R1, R2) having different values.

5. Device for measuring the speed and direction of rotation of an object (3) according to claim 4, characterised in that each comparator (C1, C2) includes a commutation element (Q5) for the current receptor means (6).

6. Device for measuring the speed and direction of rotation of an object (3) according to any of claims 1 to 5, characterised in that the modulated current (Iout) has a first asymmetric form when the object turns in one direction and the same form but seen in a mirror when the object (3) turns in the other direction.

7. Device for measuring the speed and direction of rotation of an object (3) according to claim 1 or 2, characterised in that the magnetic detection device (2) is a digital sensor delivering a signal representative of the speed and a signal representative of the direction of rotation of the object.

8. Device for measuring the speed and direction of rotation of an object (3) according to any of claims 1 to 3, 7, characterised in that the modulated current (I_{out}) has a cyclic ratio greater than a predetermined threshold when the object (3) turns in one direction and a cyclic ratio less than the predetermined threshold when the object (3) turns in the other direction.

9. Device for measuring the speed and direction of rotation of an object (3) according to claim 8 linked to any of claims 1 to 3, characterised in that it comprises two comparators (C1, C2), the input of each receiving the signals of a pair, means of encoding (50) the direction of rotation of the object, the input of which is connected to the output of the comparators (C1, C2), means of mixing (51), the input of which is connected to the output of the comparators (C1, C2) and to the output of the means of encoding (50), the output of the means of mixing (51) delivering a unique signal (S) reflecting the speed and direction of rotation of the object (3), said unique signal controlling the current receptor means (6).

10. Device for measuring the speed and direction of rotation of an object (3) according to claim 9, characterised in that the means of encoding (50) the direction of rotation comprises a switchover D.

11. Device for measuring the speed and direction of rotation of an object (3) according to claim 8 linked to claim 7, characterised in that it comprises, means of mixing (83), the input of which is connected to the magnetic detection device (80) and the output of which delivers a unique signal (S) reflecting the speed and

direction of rotation of the object (3), said unique signal controlling the current receptor means (6).

12. Device for measuring the speed and direction of rotation of an object (3) according to any of claims 9 to 11, characterised in that the means of mixing (51, 83) are formed by a circuit based on logic gates (60 to 65, 800 to 805).

13. Device for measuring the speed and direction of rotation of an object (3) according to any of claims 1 to 12, characterised in that the magnetic detection device (3, 80), the conductor (4) and the current receptor means (6) at least are encapsulated in an enclosure (1) made out of non-magnetic material, the conductor (4) being accessible from the exterior of said enclosure (1).

14. Device for measuring the speed and direction of rotation of an object (3) according to claim 13, characterised in that the enclosure (1) is formed out of metal such as titanium or stainless steel.

15. Device for measuring the speed and direction of rotation of an object (3) according to any of claims 1 to 14, characterised in that the magnetic detection device (3, 80) is connected to another conductor (5) for its power supply, said other conductor (5) coming into electrical contact with the enclosure (1).

16. Device for measuring the speed and direction of rotation of an object (3) according to any of claims 1 to 15, characterised in that it further comprises an object (3) in the form of a non-magnetic propeller (30) integral with at least one magnet (31).

17. Device for measuring the speed and direction of rotation of an object (3) according to claim 16, characterised in that the propeller (30) and the measuring device are in the same line as each other, along the axis of the propeller.